

**Space Science Seminar
Thursday, 2015 February 19
10:30 a.m.
NSSTC/2096**

From GRBs to LIGO Discoveries: The Needle in the 100-Square-Degree Haystack

Dr. Leo P. Singer / NASA / GSFC

The Advanced LIGO and Virgo experiments are poised to detect gravitational waves (GWs) directly for the first time this decade. The ultimate prize will be joint observation of a compact-binary merger in both gravitational and electromagnetic channels. However, GW sky locations that are uncertain by hundreds of square degrees will pose a challenge. I describe a real-time detection pipeline and a rapid Bayesian parameter estimation code that will make it possible to search promptly for optical counterparts in Advanced LIGO. Having analyzed a comprehensive population of simulated GW sources, we describe the sky localization accuracy that the GW detector network will achieve as each detector comes online and progresses toward design sensitivity. Next, in preparation for the optical search with the intermediate Palomar Transient Factory (iPTF), we have developed a unique capability to detect optical afterglows of gamma-ray bursts (GRBs) detected by the Fermi Gamma-ray Burst Monitor (GBM); its comparable error regions offer a close parallel to the Advanced LIGO problem, but Fermi's unique access to MeV-GeV photons and its near all-sky coverage may allow us to look at optical afterglows in a relatively unexplored part of the GRB parameter space. We present the discovery and broadband follow-up observations of eight GBM-iPTF afterglows. Two of the bursts are at low redshift, are sub-luminous with respect to "standard" cosmological bursts, and have spectroscopically confirmed broad-line type Ic supernovae. These two bursts are possibly consistent with mildly relativistic shocks breaking out from the progenitor envelopes rather than the standard mechanism of internal shocks within an ultra-relativistic jet. On a technical level, the GBM-iPTF effort is a prototype for locating and observing optical counterparts of GW events in Advanced LIGO with the Zwicky Transient Facility.

<http://solarscience.msfc.nasa.gov/colloquia/>